

In the Claims:

Please amend Claims 1, 21-23, 30-32, 35, 36, 40-42, and 49; cancel Claims 20, 24, 25, 37, 45-48, and 50 without prejudice; and add new Claims 55-97, such that the claims read as set forth below.

1. (Currently Amended) A composition for chemical-mechanical polishing, comprising:
at least one oxidizing agent; and
at least one abrasive particle having a surface at least partially coated by a catalyst that is substantially insoluble in the composition, the catalyst comprising a ~~metal other than a metal of Group 4(b), Group 5(b) or Group 6(b)~~ material selected from a group consisting of a metal, an oxide of a metal, a source of ionic metal, and any combination thereof, the metal being selected from a group consisting of metals in Group 1(b) and Group 8.

2. (Original) The composition of claim 1, wherein the oxidizing agent comprises a per compound.

3. (Original) The composition of claim 1, wherein the oxidizing agent comprises ozone.

4. (Original) The composition of claim 1, wherein the oxidizing agent comprises an agent selected from a group consisting of a metal salt, a metal complex, and any combination thereof.

5. (Original) The composition of claim 1, wherein the oxidizing agent is selected from a group consisting of hydroxylamine, a salt of hydroxylamine, and any combination thereof.

6. (Original) The composition of claim 1, wherein the oxidizing agent is in an amount of from about 0.01 to about 30 weight percent relative to the composition.

7. (Original) The composition of claim 1, wherein the oxidizing agent is in an amount of from about 0.01 to about 10 weight percent relative to the composition.

8. (Original) The composition of claim 1, wherein the oxidizing agent is in an amount of from about 0.01 to about 6 weight percent relative to the composition.

9. (Original) The composition of claim 1, wherein the at least one abrasive particle comprises a metal oxide.

10. (Original) The composition of claim 1, wherein the at least one abrasive particle comprises a material selected from a group consisting of alumina, ceria, germania, silica, spinel, titania, an oxide of tungsten, zirconia, and any combination thereof.

11. (Original) The composition of claim 1, wherein the at least one abrasive particle comprises a metal oxide produced by a process selected from a group consisting of a sol-gel process, a hydrothermal process, a plasma process, a fuming process, a precipitation process, and any combination thereof.

12. (Original) The composition of claim 1, wherein the at least one abrasive particle comprises a resinous particle.

13. (Original) The composition of claim 1, wherein the at least one abrasive particle comprises a material selected from a group consisting of a polyacrylic acid, a polymethylacrylic acid, a polymelamine, a particle of an ion exchange resin, and any combination thereof.

14. (Original) The composition of claim 1, wherein the at least one abrasive particle comprises a plastic particle.

15. (Original) The composition of claim 1, wherein the at least one abrasive particle comprises a material selected from a group consisting of a polyacrylic acid, a polymethylacrylic acid, a polyvinyl alcohol, and any combination thereof.

16. (Original) The composition of claim 1, wherein an effective diameter of the at least one abrasive particle is from about 30 to about 170 nanometers.

17. (Original) The composition of claim 1, wherein the at least one abrasive particle and the catalyst on the surface thereof together are in an amount of from about 0.01 to about 50 weight percent relative to the composition.

18. (Original) The composition of claim 1, wherein the at least one abrasive particle and the catalyst on the surface thereof together are in an amount of from about 0.01 to about 20 weight percent relative to the composition.

19. (Original) The composition of claim 1, wherein the at least one abrasive particle and the catalyst on the surface thereof together are in an amount of from about 0.01 to about 10 weight percent relative to the composition.

20. (Cancelled)

21. (Currently Amended) The composition of claim 1, where the catalyst ~~comprises a metal having~~ has a standard oxidation potential of from about -0.52 to about -0.25 eV.

22. (Currently Amended) The composition of claim 1, where the catalyst ~~comprises a metal having~~ has a standard oxidation potential of from about -0.5 to about -0.4 eV.

23. (Currently Amended) The composition of claim 1, wherein the catalyst ~~comprises a metal~~ is selected from a group consisting of cobalt, copper, iron, and any combination thereof.

24. (Cancelled)

25. (Cancelled)

26. (Original) The composition of claim 1, wherein the catalyst coats from about 5 to about 100 percent of the surface of the at least one abrasive particle.

27. (Original) The composition of claim 1, wherein the catalyst coats from about 5 to about 80 percent of the surface of the at least one abrasive particle.

28. (Original) The composition of claim 1, wherein the catalyst coats from about 25 to about 50 percent of the surface of the at least one abrasive particle.

29. (Original) The composition of claim 1, further comprising at least one other abrasive that is free of a catalyst coating.

30. (Currently Amended) The composition of claim 1 ~~wherein~~ wherein the other abrasive is in an amount of from about 0.01 to about 30 weight percent relative to the composition.

31. (Currently Amended) The composition of claim 1 ~~wherein~~ wherein the other abrasive is in an amount of from about 0.01 to about 20 weight percent relative to the composition.

32. (Currently Amended) The composition of claim 1 ~~wherein~~ wherein the other abrasive is in an amount of from about 0.01 to about 10 weight percent relative to the composition.

33. (Original) The composition of claim 1, further comprising an additive selected from a group consisting of a polish-enhancement agent, a stabilization agent, a surfactant, a dispersion agent, a pH-adjusting agent, and any combination thereof.

34. (Original) The composition of claim 33, wherein the additive is present in an amount of from about 0.001 to about 2 weight percent relative to the composition.

35. (Currently Amended) The composition of claim 1, wherein a pH level of the composition is from about 2 to about 11.

36. (Currently Amended) The composition of claim 1, wherein a pH level of the composition is from about 2 to about 8.

37. (Cancelled)

38. (Original) The composition of claim 1, the composition sufficient for chemical-mechanical polishing of a substrate surface having a feature thereon comprising a first material selected from a group consisting of aluminum, copper, titanium, tungsten, any alloy thereof, and any combination thereof.

39. (Original) The composition of claim 38, the composition sufficient for chemical-mechanical polishing of the substrate surface comprising a second material adjacent the feature, the second material selected from a group consisting of tantalum, tantalum nitride, titanium, titanium nitride, titanium tungsten, tungsten, and any combination thereof.

40. (Currently Amended) A method of polishing a substrate surface having at least one feature thereon comprising a metal, comprising:

providing the composition of any one of claims 1[[-5, 9, 12-14, and 20-25]] and 23;
and

chemical-mechanical polishing the feature with the composition.

41. (Currently Amended) The method of claim 40, wherein said providing comprises combining the at least one abrasive particle, the surface of which is at least partially coated with the catalyst, with a prepared composition, the prepared composition lacking a catalyst-coated abrasive and comprising ~~an~~ the oxidizing agent.

42. (Currently Amended) The method of claim 40, wherein the metal of the feature is selected from a group consisting of aluminum, copper, titanium, tungsten, any alloy thereof, and any combination thereof.

43. (Original) The method of claim 40, wherein the feature is adjacent a material selected from a group consisting of tantalum, tantalum nitride, titanium, titanium nitride, titanium tungsten, tungsten, and any combination thereof.

44. (Original) The method of claim 40, wherein the chemical-mechanical polishing comprises applying a pressure of from about 1 to about 6 pounds per square inch to the feature.

45-48. (Cancelled)

49. (Currently Amended) ~~A substrate having a surface comprising at least one feature thereon comprising a metal, said substrate~~ produced by the method of claim 40, the substrate comprising the substrate surface, wherein the metal of the feature is selected from a group consisting of aluminum, copper, titanium, tungsten, any alloy thereof, and any combination thereof.

50. (Cancelled)

51. (Original) The substrate of claim 49, wherein the feature is adjacent a material selected from a group consisting of tantalum, tantalum nitride, titanium, titanium nitride, titanium tungsten, tungsten, and any combination thereof.

52. (Original) The substrate of claim 49, the substrate surface having from about zero to about 40 percent within-wafer nonuniformity.

53. (Original) The substrate of claim 49, the substrate surface having from about zero to about 12 percent within-wafer nonuniformity.

54. (Original) The substrate of claim 49, wherein any microscratch on the substrate surface produced during the chemical-mechanical polishing is less than about 20 Angstroms.

55. (New) The composition of claim 1, wherein the at least one abrasive particle comprises silica.

56. (New) The composition of claim 1, wherein the metal comprises iron and the at least one abrasive particle comprises silica.

57. (New) A composition for chemical-mechanical polishing, comprising:
at least one oxidizing agent;
at least one abrasive particle;
a catalyst comprising a material selected from a group of a metal, an oxide of a metal, an acetate of a metal, a source of ionic metal, and any combination thereof, the metal being selected from a group consisting of cobalt, copper, nickel, iron, and any combination thereof, there being a physical connection between the catalyst and at least a portion of the abrasive particle.

58. (New) A composition for chemical-mechanical polishing, comprising:
at least one oxidizing agent selected from a group consisting of a hydrogen peroxide, a hydroxylamine, a persulfate, a peracetic acid, a periodic acid, any salt thereof, and any combination thereof;
at least one abrasive particle;
a catalyst comprising a material selected from a group consisting of iron, an oxide of iron, an acetate of iron, a source of ionic iron, copper, an oxide of copper, an acetate of copper, a source of ionic copper, and any combination thereof, there being a physical connection between the catalyst and at least a portion of the abrasive particle.

59. (New) A composition for chemical-mechanical polishing, comprising:
at least one oxidizing agent;
at least one abrasive particle;
a catalyst comprising a material selected from a group of a metal, an oxide of a metal, an acetate of a metal, a source of ionic metal, and any combination thereof, the metal being selected from a group consisting of metal selected from a group consisting of cobalt, copper, nickel, iron, and any combination thereof, the catalyst and the oxidizing agent interacting to generate free radicals.

60. (New) The composition of claim 59, there being a physical connection between the catalyst and at least a portion of the abrasive particle.

61. (New) The composition of claim 59, wherein the free radicals comprise hydroxyl free radicals.

62. (New) The composition of any of claims 57 and 59, wherein the oxidizing agent comprises a per compound.

63. (New) The composition any of claims 57 and 59, wherein the oxidizing agent comprises ozone.

64. (New) The composition of any of claims 57 and 59, wherein the oxidizing agent comprises an agent selected from a group consisting of a metal salt, a metal complex, and any combination thereof.

65. (New) The composition of any of claims 57 and 59, wherein the oxidizing agent is selected from a group consisting of hydroxylamine, a salt of hydroxylamine, and any combination thereof.

66. (New) The composition of any of claims 57, 58 and 59, wherein the oxidizing agent is in an amount of from about 0.01 to about 6 weight percent relative to the composition.

67. (New) The composition of any of claims 57, 58 and 59, wherein the at least one abrasive particle comprises a material selected from a group consisting of alumina, ceria, germania, silica, spinel, titania, an oxide of tungsten, zirconia, and any combination thereof.

68. (New) The composition of any of claims 57, 58 and 59, wherein the at least one abrasive comprises silica.

69. (New) The composition of any of claims 57, 58 and 59, wherein the at least one abrasive particle comprises a material selected from a group consisting of a polyacrylic acid, a polymethylacrylic acid, a polyvinyl alcohol, a polymelamine, a particle of an ion exchange resin, and any combination thereof.

70. (New) The composition of any of claims 57, 58 and 59, wherein an effective diameter of the at least one abrasive particle is from about 30 to about 170 nanometers.

71. (New) The composition any of claims 57, 58 and 59, wherein the at least one abrasive particle comprises aggregated or agglomerated particles.

72. (New) The composition of any of claims 57, 58 and 59, wherein the catalyst comprises a material selected from iron acetate, copper acetate, and any combination thereof.

73. (New) The composition of any of claims 57, 58 and 59, wherein the catalyst is in physical connection with from about 5 to about 80 percent of the surface of the abrasive particle.

74. (New) The composition of any of claims 57, 58 and 59, wherein the catalyst is in physical connection with from about 25 to about 50 percent of the surface of the abrasive particle.

75. (New) The composition of any of claims 57, 58 and 59, further comprising at least one free abrasive that is free of a physical connection with catalyst.

76. (New) The composition of claim 75, wherein the free abrasive is in an amount of from about 0.01 to about 10 weight percent relative to the composition.

77. (New) The composition of any of claims 57, 58 and 59, further comprising a free catalyst that is free in the composition in an amount sufficient to avoid destabilization of the composition.

78. (New) The composition of any of claims 57, 58 and 59, further comprising a free catalyst that is free in the composition in an amount sufficient to avoid degradation of the oxidizing agent.

79. (New) The composition of any of claims 57, 58 and 60, wherein the at least one abrasive particle and the catalyst in physical connection therewith together are in an amount of from about 0.01 to about 10 weight percent relative to the composition.

80. (New) The composition of any of claims 57, 58 and 60, wherein the at least one abrasive particle and the catalyst in physical connection therewith together are in an amount of about 0.5 weight percent relative to the composition.

81. (New) The composition of any of claims 57, 58 and 60, the physical connection selected from a group consisting of a formation of at least a partial layer of the catalyst on at least a portion of the abrasive, an absorption of the catalyst on at least a portion of the abrasive, an adsorption of the catalyst on at least a portion of the abrasive, and an adhesion of the catalyst on at least a portion of the abrasive.

82. (New) The composition of any of claims 57, 58 and 60, the physical connection sufficient to remain substantially in tact during chemical-mechanical polishing.

83. (New) The composition of any of claims 57, 58 and 60, the physical connection sufficient such that the catalyst is not free in the composition.

84. (New) The composition of any of claims 57, 58 and 60, the physical connection sufficient such that the metal is not free in the composition.

85. (New) The composition of any of claims 57, 58 and 59, further comprising an additive selected from a group consisting of a polish-enhancement agent, a stabilization agent, a surfactant, a dispersion agent, a pH-adjusting agent, and any combination thereof.

86. (New) The composition of claim 85, wherein the additive is present in an amount of from about 0.001 to about 2 weight percent relative to the composition.

87. (New) The composition of any of claims 57, 58 and 59, wherein a pH of the composition is from about 2 to about 8.

88. (New) The composition of any of claims 57, 58 and 59, the composition sufficient for chemical-mechanical polishing of a substrate surface having a feature thereon comprising a first material selected from a group consisting of aluminum, copper, titanium, tungsten, any alloy thereof, and any combination thereof.

89. (New) The composition of claim 88, the composition sufficient for chemical-mechanical polishing of the substrate surface comprising a second material adjacent the feature, the second material selected from a group consisting of tantalum, tantalum nitride, titanium, titanium nitride, titanium tungsten, tungsten, and any combination thereof.

90. (New) A method of polishing a substrate surface having at least one feature thereon comprising a metal, comprising:

providing the composition of any one of claims 57, 58 and 59; and
chemical-mechanical polishing the feature with the composition.

91. (New) The method of claim 90, wherein the metal of the feature is selected from a group consisting of aluminum, copper, titanium, tungsten, any alloy thereof, and any combination thereof.

92. (New) The method of claim 90, wherein the feature is adjacent a material selected from a group consisting of tantalum, tantalum nitride, titanium, titanium nitride, titanium tungsten, tungsten, and any combination thereof.

93. (New) The method of claim 90, wherein the chemical-mechanical polishing comprises applying a pressure of from about 1 to about 6 pounds per square inch to the feature.

94. (New) The method of claim 90, said method sufficient to provide the substrate surface with about zero to about 12 percent within-wafer nonuniformity.

95. (New) A substrate produced by the method of claim 90, the substrate comprising the substrate surface, the metal of the feature being selected from a group consisting of aluminum, copper, titanium, tungsten, any alloy thereof, and any combination thereof.

96. (New) The substrate of claim 95, wherein the feature is adjacent a material selected from a group consisting of tantalum, tantalum nitride, titanium, titanium nitride, titanium tungsten, tungsten, and any combination thereof.

97. (New) The substrate of claim 95, the substrate surface having from about zero to about 12 percent within-wafer nonuniformity.